Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

CHEMISTRY

UNIT 1: CHEMICAL SUBSTANCES, REACTIONS AND ESSENTIAL RESOURCES
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**11**	
3.	**7**	
4.	**10**	
5.	**5**	
6.	**7**	
7.	**8**	
8.	**6**	
9.	**10**	
10.	**7**	
Total	**80**	

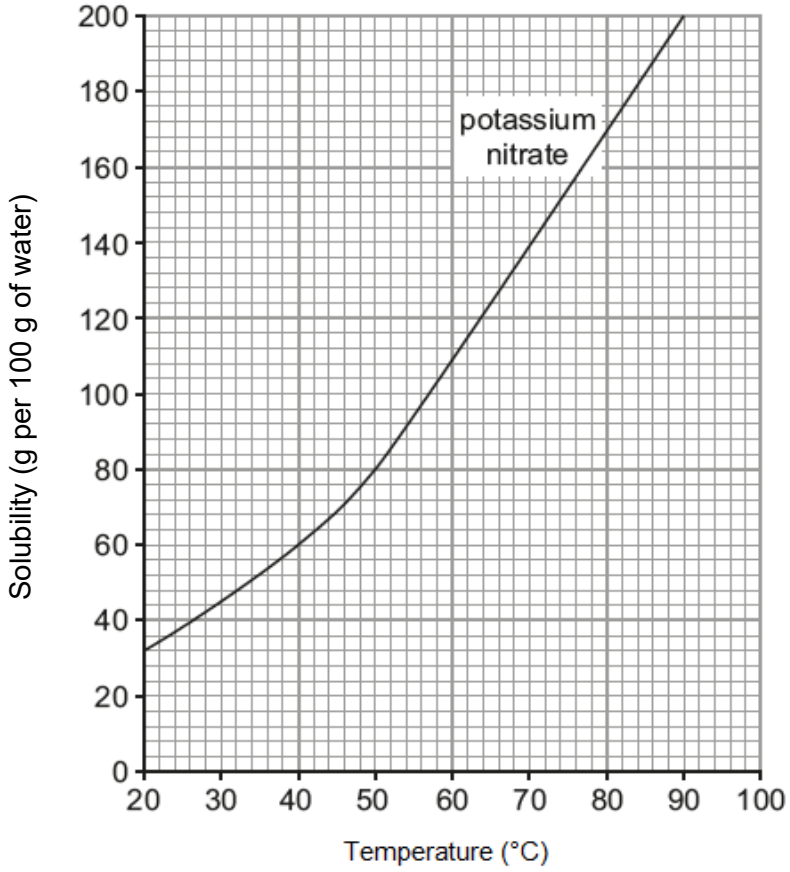
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **8** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions.*

1. The graph shows the solubility curve of potassium nitrate.



(a) The table shows the solubility of lead nitrate at different temperatures.

Temperature (°C)	20	40	60	80	100
Solubility of lead nitrate (g per 100 g of water)	52	72	90	112	136

(i) Plot the solubility of lead nitrate on the grid above. [3]

(ii) Using the graphs, compare the solubilities of potassium nitrate and lead nitrate between 20 °C and 100 °C. [3]

……

……

……

……

(b) Lucy wanted to find the solubility of substance **X** at room temperature. She measured 20.0 g of the substance into a conical flask and added 50.0 g of water. She stirred the mixture carefully until no more solid dissolved. She then separated the undissolved solid using a filter paper and dried the paper and solid overnight before weighing.

Her results were as follows.

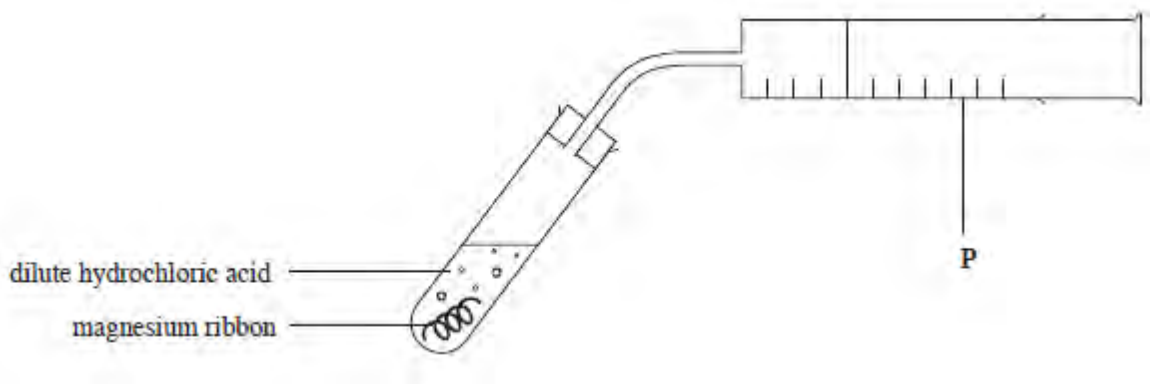
Mass of dry filter paper + substance **X** = 5.1 g
Mass of dry filter paper = 0.2 g

Use this information to calculate the solubility of substance **X** in g per 100 g of water. [3]

solubility = …… g per 100 g of water

9

2. Trystan carried out an investigation into the reaction between dilute hydrochloric acid (HCl) and magnesium ribbon. He reacted the magnesium with five different concentrations of acid and measured the volume of hydrogen gas produced after 30 s using the apparatus below.



(a) Name apparatus **P**. …….. [1]

(b) Trystan's result are shown below.

Concentration of HCl (mol/dm^3)	Volume of H_2 gas produced (cm^3)
0.2	8
0.5	17
1.0	26
1.5	30
2.0	30

(i) State what can be concluded about the effect of concentration of acid on the rate of the reaction. Explain this effect using your understanding of particle theory. [3]

……

……

……

……

(ii) Trystan initially measured the volume of gas collected in 60 s. Explain why he amended his plan after making these measurements. [2]

……

……

……

……

(iii) State **two** factors other than concentration which could affect the rate of the reaction between hydrochloric acid and magnesium. [2]

Factor 1……

Factor 2……

(c) Limestone is made of calcium carbonate. It reacts slowly with acid rain and is gradually eaten away.

Design an experiment based on this reaction to identify which of three samples of rainwater is the most acidic. [3]

……..

……..

……..

……..

3. (a) Carbon dioxide and oxygen levels in the atmosphere are kept in balance by the carbon cycle. State and explain how **two** *biological* processes help keep this balance. [2]

……..

……..

……..

……..

(b) Many scientists believe that an increase in the use of fossil fuels has led to global warming.

(i) Describe how global warming is different to the greenhouse effect. [1]

……

……

(ii) Describe **two** possible consequences of continued global warming over the next century. [2]

……

……

……

(iii) Explain the principle of carbon capture and storage as a method of limiting future global warming. [2]

……

……

……

……

7

4. (a) When a metal carbonate undergoes thermal decomposition it releases a gas and forms a metal oxide. The table gives the temperature at which some carbonates decompose.

Metal carbonate	**Decomposition temperature (˚C)**
calcium carbonate	840
copper(II) carbonate	290
magnesium carbonate	350
potassium carbonate	890

(i) State which carbonate is the most stable and give a reason for your answer. [1]

……

……

(ii) Describe an experiment to show the thermal decomposition of copper(II) carbonate. Include the observations made and state how you would collect and identify the gas formed.

You may include a diagram in your answer. [4]

……

……

……

……

……

……

(iii) A student was given samples of each of these carbonates labelled **A**, **B**, **C** and **D**. He made the following observations.

Metal carbonate	Appearance	Colour seen in flame test
A	white powder	brick-red
B	white powder	lilac
C	green powder	green
D	white powder	no colour

State the conclusions that he should draw from both sets of observations. [2]

……

……

……

……

(b) Metal nitrates, such as potassium nitrate, also undergo thermal decomposition.

(i) Balance the chemical equation for this reaction. [1]

$\square\ KNO_3 \rightarrow \square\ KNO_2 + O_2$

(ii) Calculate the percentage of oxygen present in KNO_3. [2]

A_r(K) = 39 A_r(N) = 14 A_r(O) = 16

percentage = …… %

10

5. Name **two** different types of tectonic plate boundary linked to volcanic activity. Describe and explain the processes taking place at both. [5]

……

……

……

……

……

……

……

5

6. The table below shows information about three Group 7 elements.

Name	Melting point (°C)	Boiling point (°C)	Colour
bromine	–7	59	orange-brown
chlorine	–107	–35	yellow-green
iodine	114	184	grey

(a) Using the information in the table state the trend in melting points down Group 7 and give the physical states of each element at room temperature (20 °C). [3]

Trend in melting points ……

……

Physical states ……

……

……

(b) Astatine lies below iodine in the Periodic Table. Predict the melting point of astatine. Explain how you reach this conclusion. [1]

Melting point ……

Explanation ……...

……

(c) Chlorine has two naturally occurring isotopes – ^{35}Cl and ^{37}Cl. The isotope containing 18 neutrons makes up 75 % of all chlorine atoms.

Calculate the relative atomic mass (A_r) of chlorine. [3]

isotope 1 isotope 2

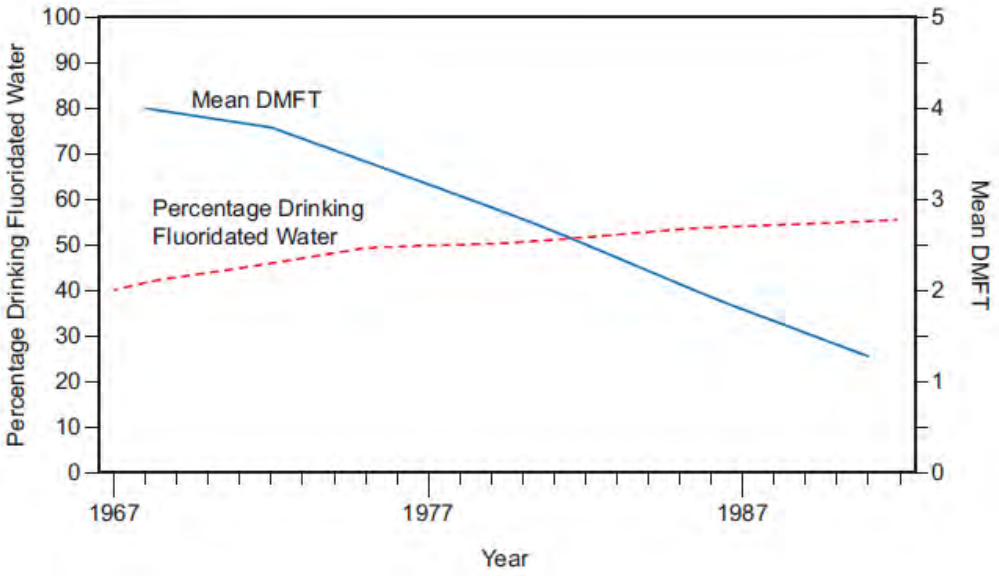
$$A_r = \frac{(\text{mass} \times \text{percentage abundance}) + (\text{mass} \times \text{percentage abundance})}{100}$$

A_r = ……

7

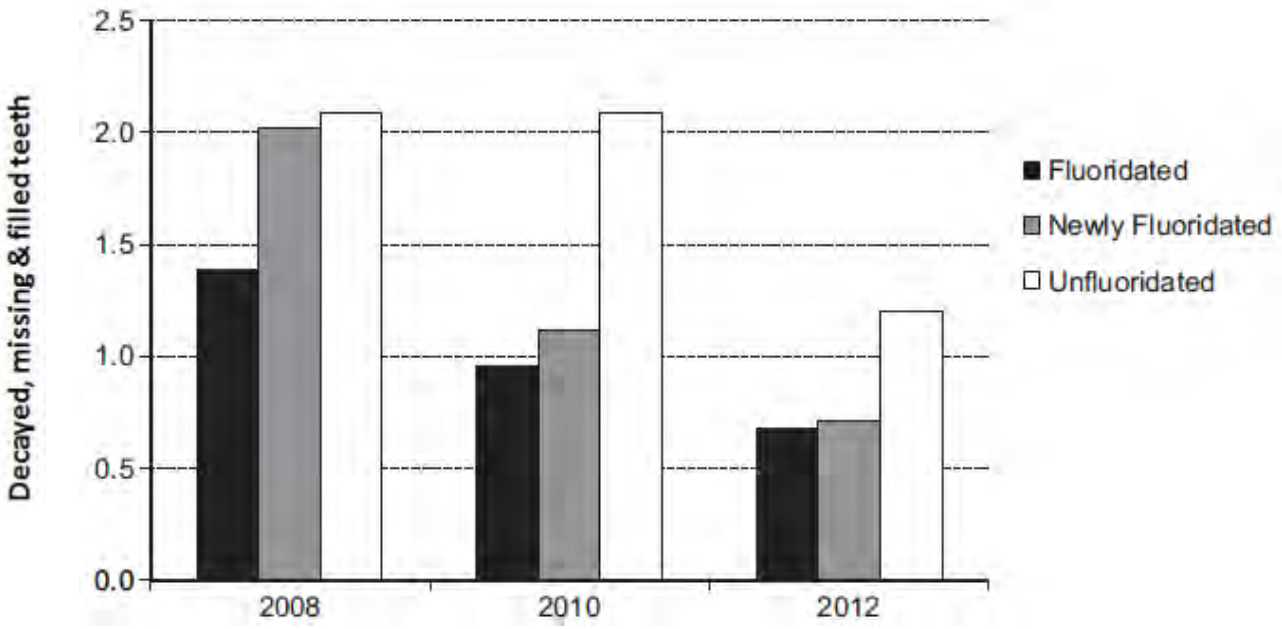
7. The graphs below show data on fluoridation of water and numbers of decayed, missing and filled teeth (DMFT) seen in the population of children aged 12.

Graph 1 shows data collated by the *Center of Disease Control* in the U.S.A. from 1967-1992.



Graph 1

Graph 2 shows data from an Australian dental paper comparing mean numbers of DMFT in three different areas. The fluoridated water area has had fluoride added to its water supply for over 20 years. The newly fluoridated area has had fluoride added since 2008. The unfluoridated area has never had fluoride added to its supply.



Graph 2

(a) Calculate the percentage decrease in mean DMFT in the newly fluoridated area between 2008 and 2010. [2]

decrease = …… %

(b) Suggest a possible reason why the levels of DMFT decreased in the unfluoridated area between 2010 and 2012. Explain your reasoning. [2]

……..

……..

……..

(c) A student claims that water should be fluoridated in order to decrease mean DMFT. Use the data from both graphs and your own knowledge to evaluate this claim. [4]

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

8

8. Discuss the methods used to soften hard water. [6 QER]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

6

9. (a) The reactivity of Group 7 elements was investigated by reacting each halogen with solutions of each halide.

(i) Complete the table below by adding a tick (✓) to indicate that a reaction takes place and a cross (✖) where no reaction occurs. [2]

Halogen	**Solution of halide ion**		
	sodium chloride	sodium iodide	sodium bromide
bromine, Br_2			
chlorine, Cl_2		✓	
iodine, I_2			

(ii) Explain the trend in reactivity in Group 7 in terms of electronic structure. [3]

……

……

……

……

……

(iii) Write the balanced **symbol** equation for the reaction that takes place between chlorine and sodium iodide. [2]

…… + …… → …… + ……

(b) Bromine and fluorine can react together to form two different compounds. One of them has a relative molecular mass (M_r) of 137 while the other is formed from 355 g of bromine and 430 g of fluorine.

Deduce the formulae of both of these compounds. Show your working throughout. [3]

A_r(Br) = 80 A_r(F) = 19

Compound 1 ……

Compound 2 ……

10

10. (a) The contact process is used to produce sulfuric acid. One step in this process is the production of sulfur trioxide shown in the following equation.

$$SO_2 + O_2 \rightarrow SO_3$$

A catalyst of vanadium pentoxide is used in this step.

State the purpose of the catalyst and explain how it is effective in **this** reaction. [2]

……..

……..

……..

(b) The sulfur dioxide required in the above reaction, can be produced by heating sulfide ores such as iron sulfide, FeS_2, in oxygen.

$$4FeS_2(s) + 11O_2(g) \rightarrow 2Fe_2O_3(s) + 8SO_2(g)$$

(i) Calculate the number of moles in 176 tonnes of SO_2. [3]

1 tonne = 1×10^9 g

A_r(S) = 32 A_r(O) = 16

number of moles = …… mol

(ii) Use you answer to part (i) to calculate the minimum mass of iron sulfide, FeS_2, required to produce 176 tonnes of SO_2. [2]

A_r(Fe) = 56 A_r(S) = 32 A_r(O) = 16

mass = …… tonnes

7

END OF PAPER

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	Formula	Name	Formula
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
									$^{1}_{1}$H Hydrogen								$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key: